Alex D. Felker
Vice President-Technology
Time Warner Telecommunications

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T I M E W A R N E R

August 13, 1993

Mr. William Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW
Washington, D.C. 20554

RE: Ex Parte Filing
Personal Communications Services
GEN Docket No. 90-314;
Emerging Technologies
ET Docket No. 92-9

Dear Mr. Caton:

Enclosed are an original and one copy of a document addressing the bandwidth requirements for new personal communications services. On this date, I provided a copy of the enclosed document to Bruce Franca during a meeting in which we discussed the subject of the enclosure. Please associate the material with the above-captioned dockets.

Sincerely,

Alex D. Felker

Alex D. Felker

Enclosure

Time Warner Telecommunications A Time Warner Entertainment Company
1776 Eye Street NW Suite 850 Washington DC 20006 Tel 202.331.9882 Fax 202.331.1731

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PCS Assignment Bandwidth of at Least 40 MHz Is Required To:

- Support Vocoder and Data Rates Competitive with Existing Wire/Wireless Nets
- Facilitate Prompt Service Availability via Band Sharing with Incumbents
- Lower Subscriber Costs
  - Increases trunking efficiency
  - Decreases investment in frequency reuse
- **Establish Coverage/Capacity Parity Between 2 GHz PCS and 800 MHz Cellular**

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30 MHz Does Not Facilitate PCS/Microwave Co-Existence

- **Microwave channels are generally 10 MHz**
  - Receiver passbands frequently wider than 10 MHz
  - Adjacent channels generally vacant
- **40 MHz pairing (20 X 20 MHz) allows access to some spectrum immediately**
- **30 MHz pairing (15 X 15 MHz) can result in:**
  - Competitors jointly negotiating with microwave licensee
  - Inability to use any portion of assignment in certain congested areas

DIFFERENCES IN PHYSICAL PROPERTIES OF 800 MHZ AND 2 GHZ

- Higher frequency signals propagate more poorly in free space
  - Results in 7.25 dB greater free space path loss at 2 GHz
- Lower handset power
  - Cellular: 600 mW; PCS: probably < 300 mW
- Greater fading at 2 GHz
  - For equivalent coverages, implies greater average received power

If the effects of these properties are not offset, 2 GHz PCS systems will require at least 4 times as many cell sites as 800 MHz cellular systems for comparable levels of coverage & capacity

CELLULAR/PCS PARITY

TO PUT PCS COVERAGE & CAPACITY ON PAR WITH CELLULAR REQUIRES:

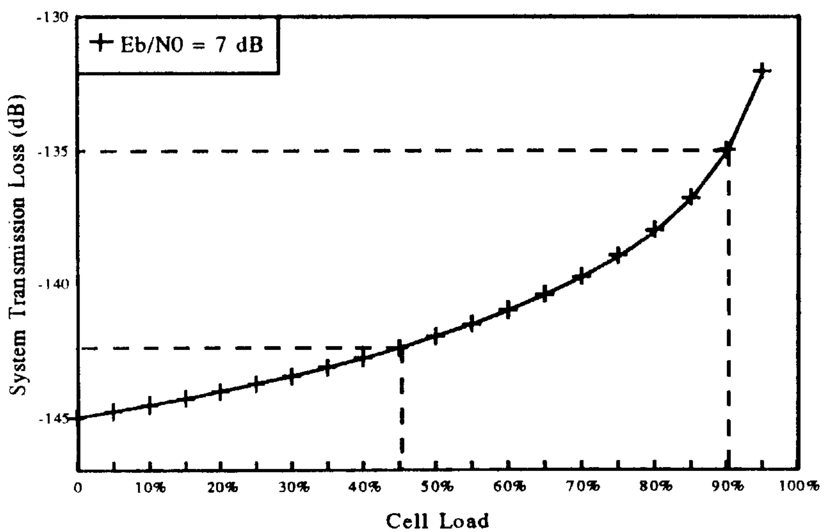
- Equivalent numbers of base stations and comparable power levels
- Sufficient spectrum to make PCS traffic handling capacity comparable to cellular

Q-CDMA PERMITS COVERAGE/CAPACITY TRADEOFF

For a given radiated power level:

- Coverage may be increased by reducing number of active voice channels
- Number of voice channels may be increased by reducing coverage

Q-CDMA SYSTEM TRANSMISSION LOSS IS A FUNCTION OF LOADING



To obtain coverage and capacity parity with cellular's 25 MHz, PCS must have at least 40 MHz of **CLEAR** spectrum

$$T(r) = CNR_{min} + (N_0W)_c - p_t - 10\log(1-X)$$

Where,
X = Loading Factor

Source: The CDMA Network Engineering Handbook Vol. I, Qualcomm, Inc; November 23, 1992

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received power spectral density ratio). The maximum cell size should be such that within the coverage area, the received pilot E_c/I_t should be above a predetermined threshold.

In the next section we shall show how the C/R, number of users in the cell and the maximum mobile transmit power determine the size of the cell on the reverse link.

7.4.1 Reverse Link Cell Size

In the following we shall not limit our discussion to a specific propagation model, rather we shall express all the results in terms of a path loss (propagation loss and fading margins) in dB. The system designer can then use coverage and best server maps to determine the actual size of the cell. At the cell, the CNR per antenna is given by

$$CNR(r) = \frac{p_t^m(r)L(r)G_cG_m}{(N_oW)_c+(N/F-1)v\,p_t^m(r)L(r)G_cG_m} \tag{7-19}$$

where

$P_t^m(r)$ = mobile's power amplifier (PA)output

$L(r)$ = reverse link path loss

G_c = cell antenna gain including cable losses

G_m = mobile antenna gain including cable losses

v = average voice activity factor

F = frequency reuse efficiency

$(N_oW)_c$ = thermal noise at the cell LNA input.

The quantity $(N_oW)_c+(N/F-1)\,v\,p_t^m(r)L(r)G_c\,G_m$ depends only on the system loading. It can be shown that [19]

$$1+(N/F-1)\,v\frac{p_t^m(r)}{(N_oW)_c}\,L(r)\,G_cG_m = \frac{1}{1-X} \tag{7-20}$$

where X is the system loading. The maximum transmission and path loss that the mobile can tolerate are then given by

$$T(r) = CNR_{min} + (N_oW)_c - p_t^m - 10 \log (1-X) \tag{7-21a}$$

$$L(r) = CNR_{min} + (N_oW)_c - p_t^m - G_c - G_m - 10 \log (1-X) \tag{7-21b}$$

For example, for a 200 mW mobile unit, 7 dB minimum E_b/N_t (E_b/N_t = CNR+21 dB processing gain), 5 dB cell receiver noise figure, and 90 % load, the transmission loss is

$$T(r) = -14 - 108 - 23 + 10 = -135\ dB$$

and the path loss (assuming 6 dB cell antenna gain and 0 dB mobile antenna gain including cable losses) is

$$L(r) = T(r) - G_c - G_m = -141\ dB$$

Any mobile within the contour defined by the above transmission loss can close the reverse link without exceeding its maximum allowable power.

Figure 7-5 demonstrates the dependence of $L(r)$ on the system loading for different E_b/N_o (all other parameters are kept the same as in the example above).